

IMPROVED STATIC ANTERIOR CERVICAL PLATE

Field of the Invention

This invention relates to the field of orthopedic surgery and, more particularly, to spinal fixation.

Background of the Invention

The use of bone pins and plates for reducing fractures is well known in orthopedic medicine. The pins and plates extend across discontinuities in a bone to fix the broken ends in relation to each other to reduce pain and promote rapid healing without deformity. These devices are secured to the bone by bone screws or nails driven into the bone. More recently, pins, rods, plates and cages have been used to stabilize bone and joints that have deteriorated naturally or as a result of prior trauma. The bone plate of this invention is useful in all these situations.

The interface between the bone screws and the bone presents problems of stability and long term usage that have been addressed in different ways. One of the major problems is usually termed as back-out. This defines the condition in which the screws attaching the plate to the bone loosen over time, either relative to the bone or the plate or both. Severe back-out results in the bone screw working itself out of the bone and/or plate resulting in instability of the bone or joint. This situation results in increasing pain and danger from the instability, as well as , the movement of the screw. There may be several reasons for the back-out but anatomical stresses from body movements contributes greatly to the problem.

Prior art devices address the problem of back-out by use of secondary locking screws that hold the bone screws in the plate. The locking device engages the head of the bone screw

1 and is tightened to fix the screw to the plate and, thus, the bone. Such devices are not
2 particularly suited for deployment on the anterior aspect of the spine because of the close
3 proximity of vital soft tissue organs which dictate a smooth, low profile, contoured surface.

4 Michelson, U. S. Patent No. 6,454,771, discloses a bone plate for anterior cervical
5 fixation. The plate has several holes for receiving bone screws. A locking screw mechanism
6 is used to overlay the screw heads.

7 An expandable insert for placement between vertebrae is disclosed by Paes et al, U.
8 S. Patent No. 6,436,142. The device is in the nature of a lag screw and can expand with the
9 insertion of an expansion screw.

10 U.S. Patent No. 6,342,055 to Eisermann et al discloses a bone plate with bone screws
11 having a snap-in retainer securing the heads to the plate.

12 Geisler, U. S. Patent No. 6,231,610, discloses a bone plate with diverging bone screws
13 and serrations on the plate to increase holding power.

14 U.S. Patent No. 6,224,602 to Hayes discloses a bone plate with multiple bone screw
15 holes which may be covered by a sliding locking plate. The bone plate has an undercut
16 channel to hold the locking plate in contact with the screw heads. The locking plate is held
17 to the plate by a locking screw once it is slid to the desired position.

18 Aust et al, U.S. Patent No. 5,603,713, discloses an anterior lumbar plate attached by
19 screws with various angular connections to the spine.

20 What is needed in the art is a bone plate that provides improved visualization of the
21 vertebral interspace for graft placement, improved ability to align and position the plate, and
22 tapped bone screws for better purchase.

SUMMARY OF THE INVENTION

Disclosed is a bone plate for use in anterior cervical spinal fixation. The bone plate has interlocking components to prevent dislodgement of the plate due to anatomical forces. The bone plate is C- shaped with a smooth exposed surface to prevent trauma to internal body tissue. The plate spans the intervertebral space with each end attached to an adjacent vertebrae by bone screws threadably engaged with tubular bone anchors. The plate has a screw lock in each end for preventing the bone screws from backing out.

It is an objective of this invention to provide a bone plate, suitable for anterior cervical fixation, having countersunk screw holes, a low profile in cross section allowing the bone plate to be countersunk into the bone and a smooth distal surface to reduce the possibility of traumatizing adjacent soft tissue during use.

Another objective of this invention is to provide a reduced width in the central portion of the bone plate for visualizing the intervertebral space below the proximal surface of the plate.

A further objective of the invention is to provide bone screws with a fluted leading end to provide a tapped bore in the bone for better purchase.

Another objective of the invention is to provide bone screws extending through the countersunk screw holes into the bone with the leading ends of the screws formed as a tap.

Yet another objective of the invention is to provide a bone plate with a sliding screw lock blocking back out of the bone screws.

Other objectives and advantages of this invention will become apparent from the following description taken in conjunction with the accompanying drawings wherein are set

1 forth, by way of illustration and example, certain embodiments of this invention. The
2 drawings constitute a part of this specification and include exemplary embodiments of the
3 present invention and illustrate various objects and features thereof.

5 **BRIEF DESCRIPTION OF THE DRAWINGS**

6 Fig. 1 is a side view, partially in section, of the plate of this invention implanted in the
7 spine;

8 Fig. 2 is a perspective of assembled bone plate system of this invention;

9 Fig. 3 is a perspective of the bone screw of this invention;

10 Fig. 4 is a perspective of the screw lock; and

11 Fig. 5 is a top plan view of the screw lock.

13 **DETAILED DESCRIPTION OF THE INVENTION**

14 The bone plate system 10 may be made from any materials having requisite strength
15 and being suitable for use in the body. One complete bone plate system is shown in Fig. 1 and
16 Fig. 2 though it is understood that several different sizes of interchangeable components may
17 be supplied together as a kit for mixing and matching components to size a system for a
18 particular patient. A kit may have several different sized bone screws 11 varying in diameter
19 and length. The different sized locking screws may have the same sized heads 13 to be used
20 in different sized bone plates 14 with screw holes and larger countersunk depressions 15 of
21 a complementary size. There may be several different sized screw locks 16 to fit into the
22 different sized screw lock slots 17 . The kit merely refers to the disassembled components that

1 can be assembled to produce an integral whole which corresponds to the anatomical features
2 of a particular patient.

3 The bone plate 14 is shaped in the form of a block letter C with a vertical staff 18
4 connected at each end to arms 19 and 20 extending normal to the staff. Each of the arms 19
5 and 20 contain two countersunk screw holes . The reduced width of the bone plate, in the area
6 between the arms, permits a clear visualization of the intervetebral space during the fitting
7 and placement of the plate.

8 Each of the arms 19 and 20 contains a screw lock slot 17 located between the
9 countersunk depressions 15 surrounding the screw holes. The screw lock slot 17 extends
10 through each arm and communicates with the countersunk depressions 15 through slits 24 in
11 the sidewalls of the countersunk depression.

12 The bone plate system 10 addresses the problem of back-out by providing several
13 locking features in the connection of the plate 14 with the bone. These locking features all
14 resist the biomechanical loads placed on the implanted system and result in an aggregate
15 resistance to movement of the components.

16 The bone screws 11 are initially inserted into the bone through pilot holes drilled in the
17 bone or by the use of guide wires. The plate 14 may be used as a guide to align the
18 longitudinal axis of the bone screws with the longitudinal axis of the countersunk screw holes
19 15' in the plate. The bone screws 11 are driven into the bone with a tool (not shown) that
20 engages the slots 28 for rotation. The exterior screw threads 21 draw the screw into its seated
21 position in the bone. However, the screw threads 21 produce a mirror image of the toroidal
22 ramp at the bone interface which is a path of least resistance in the opposite direction. The

1 leading or proximal end of the screw 11 has a number of flutes 25 in the side wall dividing
2 the proximal circumference into segments 26. Further, the leading end is tapered toward a
3 smaller end. This tap structure of the leading end of the bone screws 11 produces a cutting or
4 sweeping function in the bone-screw interface by collecting *debris* as the screw is inserted to
5 provide a smooth bore in the bone for the following threads.

6 Once the bone screws 11 are extended through the screw holes of the bone plate 14
7 with the threads 22 threadably engaging the interior of the smooth bone bore, the locking
8 screws are rotated by a tool (not shown) fitted into the receptacle 28. As shown, the bone
9 screw 11 has a smooth unthreaded shank near the head 13. The leading end of the screw has
10 a tapered portion 23 to engage the leading end of a pilot hole in the bone. The bone screw
11 heads 13 are surrounded by the depressions 15 and compressively disposed against the bottoms
12 of the depressions. Therefore, the screw 11 is locked in place by a smooth new bone-anchor
13 interface and the screw threads engage the walls of the bore. Of course, other combinations
14 of locking screws and anchor configurations may be used, such as, a constant taper of each.

15 The anterior surface of the vertebrae V and the plate 10 form a low profile interface,
16 as shown in Fig. 3. This is especially important in reducing the possibility of internal trauma
17 to adjacent soft tissue, e.g., in the anterior cervical spinal fixation. The plate is curved to
18 further conform the plate to the anatomy and reduce the silhouette.

19 After the screws 11 have been seated in the depressions 15, the screw lock 16 is placed
20 in the screw lock slot 17 formed in the plate 14. The screw lock 16 has a substantially flat
21 elongated body 30 with a narrow central extension 31 on one end. The extension 31 is located
22 between two longitudinal slots 32 and 33 formed in the body 30. The slots 32 and 33 provide

1 some resilience to the shape of the body 30 to maintain the screw lock 16 in the screw lock slot
2 17. The longitudinal edges of the body are preferably thinned at 34 and 35 to allow the screw
3 lock 17 to slide over the screw heads 13. In one embodiment, the screw lock 16 may be
4 tapered from a larger thickness opposite the central extension 31 to wedge into slot 17 as the
5 screw lock is inserted into the slot.

6 The assembly is completed by sliding the screw locks 16 through the arms 19 and 20
7 with the thinned edges 34 and 35 of the body 30 extending through the slits 24 to forcibly
8 engage the screw heads 13. The forces produced by the frictional contact of the screw lock
9 with the screw lock slot and the screw heads firmly wedges the screw lock in place and
10 prevents the lock screws from backing out.

11 The implanted bone plate system results in a positive lock at the proximal ends of the
12 bone anchors and locking screws and an additional lock at the distal end of the locking screws.
13 If the plate must be removed, at some later date, forceps may be applied to the extension 31
14 and the arms 19 and 20 to force the screw lock from the screw lock slot.